WE CLAIM:

1. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is expanded to an intermediate pressure;

(3) said expanded cooled natural gas stream is directed into a distillation column wherein said stream is separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it;

(5) said condensed portion is divided into at least two portions to form thereby said condensed stream and a liquid stream; and

(6) said liquid stream is directed into said distillation column as a top feed thereto.

2. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby at least a vapor stream and a first liquid stream;

(3) said vapor stream is expanded to an intermediate pressure;

(4) said first liquid stream is expanded to said intermediate pressure;

(5) at least said expanded vapor stream and said expanded first liquid stream are directed into a distillation column wherein said streams are separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it;

(7) said condensed portion is divided into at least two portions to form thereby said condensed stream and a second liquid stream; and

(8) said second liquid stream is directed into said distillation column as a top feed thereto.

3. . In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is divided into at least a first gaseous stream and a second gaseous stream;

(3) said first gaseous stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(4) said second gaseous stream is expanded to said intermediate pressure;

(5) said expanded substantially condensed gaseous first stream and said expanded gaseous second stream are directed into a distillation column wherein said streams are separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components; and

(6) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

4. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a liquid stream;

(3) said vapor stream is divided into at least a first gaseous stream and a second gaseous stream;

(4) said first gaseous stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(5) said second gaseous stream is expanded to said intermediate pressure;

(6) said liquid stream is expanded to said intermediate pressure;

(7) said expanded substantially condensed gaseous first stream, said expanded gaseous second stream, and said expanded liquid stream are directed into a distillation

column wherein said streams are separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components; and

(8) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

5. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a liquid stream;

(3) said vapor stream is divided into at least a first gaseous stream and a second gaseous stream;

(4) said first gaseous stream is combined with at least a portion of said liquid stream, forming thereby a combined stream;

(5) said combined stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(6) said second gaseous stream is expanded to said intermediate pressure;

(7) any remaining portion of said liquid stream is expanded to said intermediate pressure;

(8) said expanded substantially condensed combined stream, said expanded gaseous second stream, and said remaining portion of said liquid stream are directed into a distillation column wherein said streams are separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components; and

(9) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

6. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is divided into at least a first gaseous stream and a second gaseous stream;

(3) said first gaseous stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(4) said second gaseous stream is expanded to said intermediate pressure;

(5) said expanded substantially condensed gaseous first stream and said expanded gaseous second stream are directed into a distillation column wherein said streams are separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it;

(7) said condensed portion is divided into at least two portions to form thereby said condensed stream and a liquid stream; and

(8) said liquid stream is directed into said distillation column as a top feed thereto.

7. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a first liquid stream;

(3) said vapor stream is divided into at least a first gaseous stream and a second gaseous stream;

(4) said first gaseous stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(5) said second gaseous stream is expanded to said intermediate pressure;

(6) said first liquid stream is expanded to said intermediate pressure;

(7) said expanded substantially condensed gaseous first stream, said expanded gaseous second stream, and said expanded first liquid stream are directed into a distillation column wherein said streams are separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it;

(9) said condensed portion is divided into at least two portions to form thereby said condensed stream and a second liquid stream; and

(10) said second liquid stream is directed into said distillation column as a top feed thereto.

8. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a first liquid stream;

(3) said vapor stream is divided into at least a first gaseous stream and a second gaseous stream;

(4) said first gaseous stream is combined with at least a portion of said first liquid stream, forming thereby a combined stream;

(5) said combined stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(6) said second gaseous stream is expanded to said intermediate pressure;

(7) any remaining portion of said first liquid stream is expanded to said intermediate pressure;

(8) said expanded substantially condensed combined stream, said expanded gaseous second stream, and said remaining portion of said first liquid stream are directed into a distillation column wherein said streams are separated into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it;

(10) said condensed portion is divided into at least two portions to form thereby said condensed stream and a second liquid stream; and

(11) said second liquid stream is directed into said distillation column as a top feed thereto.

9. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is expanded to an intermediate pressure;

(3) said expanded cooled natural gas stream is separated to provide thereby a vapor stream and a liquid stream;

(4) said liquid stream is expanded to a lower intermediate pressure;

(5) said expanded liquid stream is directed into a distillation column wherein said stream is separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) said more volatile vapor distillation stream is combined with said vapor stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(7) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

10. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a first vapor stream and a first liquid stream;

(3) said first vapor stream is expanded to an intermediate pressure;

(4) said expanded first vapor stream is separated to provide thereby a second vapor stream and a second liquid stream;

(5) said second liquid stream is expanded to a lower intermediate pressure;

(6) said first liquid stream is expanded to said lower intermediate pressure;

(7) said expanded second liquid stream and said expanded first liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) said more volatile vapor distillation stream is combined with said second vapor stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(9) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

11. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a volatile residue gas fraction containing a major portion of said methane and lighter components and a first liquid stream;

(3) said first liquid stream is directed into a distillation column wherein said stream is separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a second liquid stream;

(5) at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second liquid stream in said contacting device; and

(6) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

12. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a first liquid stream;

(3) said vapor stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a volatile residue gas fraction containing a major portion of said methane and lighter components and a second liquid stream;

(4) said first liquid stream is expanded to said intermediate pressure;

(5) said second liquid stream and said expanded first liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a third liquid stream;

(7) at least a portion of said expanded vapor stream is intimately contacted with at least part of said third liquid stream in said contacting device; and

(8) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

13. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a first vapor stream and a first liquid stream;

(3) said first liquid stream is directed into a distillation column wherein said stream is separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a second vapor stream and a second liquid stream;

(5) a portion of said second liquid stream is directed into said distillation column as a top feed thereto;

(6) at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of the remaining portion of said second liquid stream in said contacting device;

(7) said first vapor stream is combined with said second vapor stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(8) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

14. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a first vapor stream and a first liquid stream;

(3) said first vapor stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a second vapor stream and a second liquid stream;

(4) said first liquid stream is expanded to said intermediate pressure;

(5) said second liquid stream and said expanded first liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a third vapor stream and a third liquid stream;

(7) a portion of said third liquid stream is directed into said distillation column as a top feed thereto;

(8) at least a portion of said expanded first vapor stream is intimately contacted with at least part of the remaining portion of said third liquid stream in said contacting device;

(9) said second vapor stream is combined with said third vapor stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(10) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

15. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a volatile residue gas fraction containing a major portion of said methane and lighter components and a first liquid stream;

(3) said first liquid stream is heated and thereafter directed into a distillation column wherein said stream is separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a second liquid stream;

(5) at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second liquid stream in said contacting device; and

(6) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

16. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a first liquid stream;

(3) said vapor stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a volatile residue gas fraction containing a major portion of said methane and lighter components and a second liquid stream;

(4) said second liquid stream is heated;

(5) said first liquid stream is expanded to said intermediate pressure;

(6) said heated second liquid stream and said expanded first liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a third liquid stream;

(8) at least a portion of said expanded vapor stream is intimately contacted with at least part of said third liquid stream in said contacting device; and

(9) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

17. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a first vapor stream and a first liquid stream;

(3) said first liquid stream is heated and thereafter directed into a distillation column wherein said stream is separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a second vapor stream and a second liquid stream;

(5) a portion of said second liquid stream is directed into said distillation column as a top feed thereto;

(6) at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of the remaining portion of said second liquid stream in said contacting device;

(7) said first vapor stream is combined with said second vapor stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(8) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

18. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a first vapor stream and a first liquid stream;

(3) said first vapor stream is expanded to an intermediate pressure and thereafter directed into a contacting device, thereby forming a second vapor stream and a second liquid stream;

(4) said second liquid stream is heated;

(5) said first liquid stream is expanded to said intermediate pressure;

(6) said heated second liquid stream and said expanded first liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said more volatile vapor distillation stream is cooled sufficiently to condense at least a part of it, thereby forming a third vapor stream and a third liquid stream;

(8) a portion of said third liquid stream is directed into said distillation column as a top feed thereto;

(9) at least a portion of said expanded first vapor stream is intimately contacted with at least part of the remaining portion of said third liquid stream in said contacting device;

(10) said second vapor stream is combined with said third vapor stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(11) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

19. The improvement according to claim 3, 4, 5, 11, 12, 13, 14, 15, 16, 17 or 18 wherein said volatile residue gas fraction is compressed and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

20. The improvement according to claim 1 or 6 wherein

(1) said volatile residue gas fraction is compressed and thereafter cooled under pressure to condense at least a portion of it; and

(2) said condensed portion is divided into at least two portions to form thereby said condensed stream and said liquid stream.

21. The improvement according to claim 2, 7, or 8 wherein

(1) said volatile residue gas fraction is compressed and thereafter cooled under pressure to condense at least a portion of it; and

(2) said condensed portion is divided into at least two portions to form thereby said condensed stream and said second liquid stream.

22. The improvement according to claim 9 wherein said more volatile vapor distillation stream is compressed and thereafter combined with said vapor stream to form said volatile residue gas fraction containing a major portion of said methane and lighter components.

23. The improvement according to claim 10 wherein said more volatile vapor distillation stream is compressed and thereafter combined with said second vapor stream to form said volatile residue gas fraction containing a major portion of said methane and lighter components.

24. The improvement according to claim 3, 4, 5, 11, 12, 13, 14, 15, 16, 17 or 18 wherein said volatile residue gas fraction is heated, compressed, and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

25. The improvement according to claim 1 or 6 wherein

(1) said volatile residue gas fraction is heated, compressed, and thereafter cooled under pressure to condense at least a portion of it; and

(2) said condensed portion is divided into at least two portions to form thereby said condensed stream and said liquid stream.

26. The improvement according to claim 2, 7, or 8 wherein

(1) said volatile residue gas fraction is heated, compressed, and thereafter cooled under pressure to condense at least a portion of it; and

(2) said condensed portion is divided into at least two portions to form thereby said condensed stream and said second liquid stream.

27. The improvement according to claim 9 wherein said more volatile vapor distillation stream is heated, compressed, cooled, and thereafter combined with said vapor stream

to form said volatile residue gas fraction containing a major portion of said methane and lighter components.

28. The improvement according to claim 10 wherein said more volatile vapor distillation stream is heated, compressed, cooled, and thereafter combined with said second vapor stream to form said volatile residue gas fraction containing a major portion of said methane and lighter components.

29. The improvement according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 22, 23, 27, or 28 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

30. The improvement according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 22, 23, 27, or 28 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

31. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) a distillation column connected to receive said expanded cooled natural gas stream, with said distillation column adapted to separate said stream into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it;

(5) dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and a liquid stream, said dividing means being further connected to said distillation column to direct said liquid stream into said distillation column as a top feed thereto; and

(6) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

32. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a first liquid stream;

(3) second expansion means connected to said separation means to receive said vapor stream and expand it to an intermediate pressure;

(4) third expansion means connected to said separation means to receive said first liquid stream and expand it to said intermediate pressure;

(5) a distillation column connected to receive said expanded vapor stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and

lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it;

(7) dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and a second liquid stream, said dividing means being further connected to said distillation column to direct said second liquid stream into said distillation column as a top feed thereto; and

(8) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

33. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) dividing means connected to said second heat exchange means to receive said cooled natural gas stream and divide it into at least a first gaseous stream and a second gaseous stream;

(3) third heat exchange means connected to said dividing means to receive said first gaseous stream and to cool it sufficiently to substantially condense it;

(4) second expansion means connected to said third heat exchange means to receive said substantially condensed first gaseous stream and expand it to an intermediate pressure;

(5) third expansion means connected to said dividing means to receive said second gaseous stream and expand it to said intermediate pressure;

(6) a distillation column connected to receive said expanded substantially condensed first gaseous stream and said expanded second gaseous stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(8) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

34. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a liquid stream;

(3) dividing means connected to said separation means to receive said vapor stream and divide it into at least a first gaseous stream and a second gaseous stream;

(4) third heat exchange means connected to said dividing means to receive said first gaseous stream and to cool it sufficiently to substantially condense it;

(5) second expansion means connected to said third heat exchange means to receive said substantially condensed first gaseous stream and expand it to an intermediate pressure;

(6) third expansion means connected to said dividing means to receive said second gaseous stream and expand it to said intermediate pressure;

(7) fourth expansion means connected to said separation means to receive said liquid stream and expand it to said intermediate pressure;

(8) a distillation column connected to receive said expanded substantially condensed first gaseous stream, said expanded second gaseous stream, and said expanded liquid stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(10) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

35. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a liquid stream;

(3) dividing means connected to said separation means to receive said vapor stream and divide it into at least a first gaseous stream and a second gaseous stream;

(4) combining means connected to said dividing means and to said separation means to receive said first gaseous stream and at least a portion of said liquid stream and combine them into a combined stream;

(5) third heat exchange means connected to said combining means to receive said combined stream and to cool it sufficiently to substantially condense it;

(6) second expansion means connected to said third heat exchange means to receive said substantially condensed combined stream and expand it to an intermediate pressure;

(7) third expansion means connected to said dividing means to receive said second gaseous stream and expand it to said intermediate pressure;

(8) fourth expansion means connected to said separation means to receive any remaining portion of said liquid stream and expand it to said intermediate pressure;

(9) a distillation column connected to receive said expanded substantially condensed combined stream, said expanded second gaseous stream, and said expanded remaining portion of said liquid stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(10) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(11) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

36. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) first dividing means connected to said second heat exchange means to receive said cooled natural gas stream and divide it into at least a first gaseous stream and a second gaseous stream;

(3) third heat exchange means connected to said first dividing means to receive said first gaseous stream and to cool it sufficiently to substantially condense it;

(4) second expansion means connected to said third heat exchange means to receive said substantially condensed first gaseous stream and expand it to an intermediate pressure;

(5) third expansion means connected to said first dividing means to receive said second gaseous stream and expand it to said intermediate pressure;

(6) a distillation column connected to receive said expanded substantially condensed first gaseous stream and said expanded second gaseous stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it;

(8) second dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and a liquid stream, said second dividing means being further connected to said distillation column to direct said liquid stream into said distillation column as a top feed thereto; and

(9) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

37. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a first liquid stream;

(3) first dividing means connected to said separation means to receive said vapor stream and divide it into at least a first gaseous stream and a second gaseous stream;

(4) third heat exchange means connected to said first dividing means to receive said first gaseous stream and to cool it sufficiently to substantially condense it;

(5) second expansion means connected to said third heat exchange means to receive said substantially condensed first gaseous stream and expand it to an intermediate pressure;

(6) third expansion means connected to said first dividing means to receive said second gaseous stream and expand it to said intermediate pressure;

(7) fourth expansion means connected to said separation means to receive said first liquid stream and expand it to said intermediate pressure;

(8) a distillation column connected to receive said expanded substantially condensed first gaseous stream, said expanded second gaseous stream, and said

expanded first liquid stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it;

(10) second dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and a second liquid stream, said second dividing means being further connected to said distillation column to direct said second liquid stream into said distillation column as a top feed thereto; and

(11) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

38. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a first liquid stream;

(3) first dividing means connected to said separation means to receive said vapor stream and divide it into at least a first gaseous stream and a second gaseous stream;

(4) combining means connected to said first dividing means and to said separation means to receive said first gaseous stream and at least a portion of said first liquid stream and combine them into a combined stream;

(5) third heat exchange means connected to said combining means to receive said combined stream and to cool it sufficiently to substantially condense it;

(6) second expansion means connected to said third heat exchange means to receive said substantially condensed combined stream and expand it to an intermediate pressure;

(7) third expansion means connected to said first dividing means to receive said second gaseous stream and expand it to said intermediate pressure;

(8) fourth expansion means connected to said separation means to receive any remaining portion of said first liquid stream and expand it to said intermediate pressure;

(9) a distillation column connected to receive said expanded substantially condensed combined stream, said expanded second gaseous stream, and said expanded remaining portion of said first liquid stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(10) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it;

(11) second dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and a second liquid stream, said second dividing means being further connected to said distillation column to direct said second liquid stream into said distillation column as a top feed thereto; and

(12) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

39. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) separation means connected to said second expansion means to receive said expanded cooled natural gas stream and separate it into a vapor stream and a liquid stream;

(4) third expansion means connected to said separation means to receive said liquid stream and expand it to a lower intermediate pressure;

(5) a distillation column connected to receive said expanded liquid stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) combining means connected to said separation means and said distillation column to receive said vapor stream and said more volatile vapor distillation stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(7) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(8) control means adapted to regulate the quantity and temperature of said feed stream to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

40. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said first separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) second separation means connected to said second expansion means to receive said expanded first vapor stream and separate it into a second vapor stream and a second liquid stream;

(5) third expansion means connected to said second separation means to receive said second liquid stream and expand it to a lower intermediate pressure;

(6) fourth expansion means connected to said first separation means to receive said first liquid stream and expand it to said lower intermediate pressure;

(7) a distillation column connected to receive said expanded second liquid stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) combining means connected to said second separation means and said distillation column to receive said second vapor stream and said more volatile vapor distillation stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(9) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(10) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

41. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) contacting and separating means connected to receive said expanded cooled natural gas stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the vapor and liquid after commingling to form a volatile residue gas fraction containing a major portion of said methane and lighter components and a first liquid stream;

(4) a distillation column connected to receive said first liquid stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(5) third heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it, thereby forming a second liquid stream;

(6) said contacting and separating means being further connected to said third heat exchange means to receive said second liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second liquid stream in said contacting device;

(7) said first heat exchange means connected to said contacting and separating means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(8) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to

maintain the overhead temperatures of said contacting and separating means and said distillation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

42. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a first liquid stream;

(3) second expansion means connected to said separation means to receive said vapor stream and expand it to an intermediate pressure;

(4) contacting and separating means connected to receive said expanded vapor stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the

vapor and liquid after commingling to form a volatile residue gas fraction containing a major portion of said methane and lighter components and a second liquid stream;

(5) third expansion means connected to said separation means to receive said first liquid stream and expand it to said intermediate pressure;

(6) a distillation column connected to receive said second liquid stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) third heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it, thereby forming a third liquid stream;

(8) said contacting and separating means being further connected to said third heat exchange means to receive said third liquid stream so that at least a portion of said expanded vapor stream is intimately contacted with at least part of said third liquid stream in said contacting device;

(9) said first heat exchange means connected to said contacting and separating means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(10) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to maintain the overhead temperatures of said contacting and separating means and said distillation

column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

43. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) contacting and separating means connected to receive said expanded cooled natural gas stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the vapor and liquid after commingling to form a first vapor stream and a first liquid stream;

(4) a distillation column connected to receive said first liquid stream, with said distillation column adapted to separate said stream into a more volatile vapor

distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(5) third heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it;

(6) separation means connected to said third heat exchange means to receive said cooled more volatile vapor distillation stream and separate it into a second vapor stream and a second liquid stream;

(7) dividing means connected to said separation means to receive said second liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said second liquid stream to said distillation column as a top feed thereto;

(8) said contacting and separating means being further connected to said dividing means to receive said second portion of said second liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second portion of said second liquid stream in said contacting device;

(9) combining means connected to said contacting and separating means and said separation means to receive said first vapor stream and said second vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(10) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool

said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(11) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to maintain the overhead temperatures of said contacting and separating means and said distillation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

44. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said first separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) contacting and separating means connected to receive said expanded first vapor stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the vapor and liquid after commingling to form a second vapor stream and a second liquid stream;

(5) third expansion means connected to said separation means to receive said first liquid stream and expand it to said intermediate pressure;

(6) a distillation column connected to receive said second liquid stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) third heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it;

(8) second separation means connected to said third heat exchange means to receive said cooled more volatile vapor distillation stream and separate it into a third vapor stream and a third liquid stream;

(9) dividing means connected to said second separation means to receive said third liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said third liquid stream to said distillation column as a top feed thereto;

(10) said contacting and separating means being further connected to said dividing means to receive said second portion of said third liquid stream so that at least a portion of said expanded first vapor stream is intimately contacted with at least part of said second portion of said third liquid stream in said contacting device;

(11) combining means connected to said contacting and separating means and said separation means to receive said second vapor stream and said third vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(12) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(13) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to maintain the overhead temperatures of said contacting and separating means and said distillation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

45. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) contacting and separating means connected to receive said expanded cooled natural gas stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the vapor and liquid after commingling to form a volatile residue gas fraction containing a major portion of said methane and lighter components and a first liquid stream;

(4) third heat exchange means connected to said contacting and separating means to receive said first liquid stream and heat it;

(5) a distillation column connected to receive said heated first liquid stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) fourth heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it, thereby forming a second liquid stream;

(7) said contacting and separating means being further connected to said fourth heat exchange means to receive said second liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second liquid stream in said contacting device;

(8) said first heat exchange means connected to said contacting and separating means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(9) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to maintain the overhead temperatures of said contacting and separating means and said distillation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

46. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) contacting and separating means connected to receive said expanded first vapor stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the vapor and liquid after commingling to form a volatile residue gas fraction containing a major portion of said methane and lighter components and a second liquid stream;

(5) third heat exchange means connected to said contacting and separating means to receive said second liquid stream and heat it;

(6) third expansion means connected to said separation means to receive said first liquid stream and expand it to said intermediate pressure;

(7) a distillation column connected to receive said heated second liquid stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) fourth heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it, thereby forming a third liquid stream;

(9) said contacting and separating means being further connected to said fourth heat exchange means to receive said third liquid stream so that at least a portion of said expanded first vapor stream is intimately contacted with at least part of said third liquid stream in said contacting device;

(10) said first heat exchange means connected to said contacting and separating means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(11) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to maintain the overhead temperatures of said contacting and separating means and said distillation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

47. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) contacting and separating means connected to receive said expanded cooled natural gas stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the vapor and liquid after commingling to form a first vapor stream and a first liquid stream;

(4) third heat exchange means connected to said contacting and separating means to receive said first liquid stream and heat it;

(5) a distillation column connected to receive said heated first liquid stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) fourth heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it;

(7) separation means connected to said fourth heat exchange means to receive said cooled more volatile vapor distillation stream and separate it into a second vapor stream and a second liquid stream;

(8) dividing means connected to said separation means to receive said second liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said second liquid stream to said distillation column as a top feed thereto;

(9) said contacting and separating means being further connected to said dividing means to receive said second portion of said second liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second portion of said second liquid stream in said contacting device;

(10) combining means connected to said contacting and separating means and said separation means to receive said first vapor stream and said second vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(11) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(12) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to maintain the overhead temperatures of said contacting and separating means and said distillation

column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

48. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said first separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) contacting and separating means connected to receive said expanded first vapor stream, with said contacting and separating means containing at least one contacting device to commingle liquid and vapor and including separating means to separate the vapor and liquid after commingling to form a second vapor stream and a second liquid stream;

(5) third heat exchange means connected to said contacting and separating means to receive said second liquid stream and heat it;

(6) third expansion means connected to said separation means to receive said first liquid stream and expand it to said intermediate pressure;

(7) a distillation column connected to receive said heated second liquid stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) fourth heat exchange means connected to said distillation column to receive said more volatile vapor distillation stream and cool it sufficiently to condense at least a part of it;

(9) second separation means connected to said fourth heat exchange means to receive said cooled more volatile vapor distillation stream and separate it into a third vapor stream and a third liquid stream;

(10) dividing means connected to said second separation means to receive said third liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said third liquid stream to said distillation column as a top feed thereto;

(11) said contacting and separating means being further connected to said dividing means to receive said second portion of said third liquid stream so that at least a portion of said expanded first vapor stream is intimately contacted with at least part of said second portion of said third liquid stream in said contacting device;

(12) combining means connected to said contacting and separating means and said second separation means to receive said second vapor stream and said third vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(13) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(14) control means adapted to regulate the quantities and temperatures of said feed streams to said contacting and separating means and said distillation column to maintain the overhead temperatures of said contacting and separating means and said distillation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

49. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) a distillation column connected to receive said expanded cooled natural gas stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded cooled natural gas stream;

(5) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(6) separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a vapor stream and a liquid stream;

(7) said distillation column being further connected to said separation means to receive said liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said liquid stream in said distillation column;

(8) combining means connected to said distillation column and said separation means to receive said more volatile vapor distillation stream and said vapor stream

and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(9) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(10) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

50. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said first separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) third expansion means connected to said first separation means to receive said first liquid stream and expand it to said intermediate pressure;

(5) a distillation column connected to receive said expanded first vapor stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded first vapor stream;

(7) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(8) second separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a second vapor stream and a second liquid stream;

(9) said distillation column being further connected to said second separation means to receive said second liquid stream so that at least a portion of said expanded

first vapor stream is intimately contacted with at least part of said second liquid stream in said distillation column;

(10) combining means connected to said distillation column and said second separation means to receive said more volatile vapor distillation stream and said second vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(11) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(12) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

51. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) a distillation column connected to receive said expanded cooled natural gas stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded cooled natural gas stream;

(5) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(6) separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a vapor stream and a liquid stream;

(7) dividing means connected to said separation means to receive said liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said

liquid stream to said distillation column at a feed location in substantially the same region wherein said vapor distillation stream is withdrawn;

(8) said distillation column being further connected to said dividing means to receive said second portion of said liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second portion of said liquid stream in said distillation column;

(9) combining means connected to said distillation column and said separation means to receive said more volatile vapor distillation stream and said vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(10) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(11) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

52. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said first separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) third expansion means connected to said first separation means to receive said first liquid stream and expand it to said intermediate pressure;

(5) a distillation column connected to receive said expanded first vapor stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded first vapor stream;

(7) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(8) second separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a second vapor stream and a second liquid stream;

(9) dividing means connected to said second separation means to receive said second liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said second liquid stream to said distillation column at a feed location in substantially the same region wherein said vapor distillation stream is withdrawn;

(10) said distillation column being further connected to said dividing means to receive said second portion of said second liquid stream so that at least a portion of said expanded first vapor stream is intimately contacted with at least part of said second portion of said second liquid stream in said distillation column;

(11) combining means connected to said distillation column and said separation means to receive said more volatile vapor distillation stream and said second vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(12) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(13) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

53. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) a distillation column connected to receive said expanded cooled natural gas stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded cooled natural gas stream;

(5) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(6) separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a vapor stream and a liquid stream;

(7) said distillation column being further connected to said separation means to receive said liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said liquid stream in said distillation column;

(8) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream from a region of said distillation column above that of said vapor withdrawing means;

(9) fourth heat exchange means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said fourth heat exchange means

being further connected to said distillation column to supply said heated liquid distillation stream to said distillation column at a location below that of said vapor withdrawing means;

(10) combining means connected to said distillation column and said separation means to receive said more volatile vapor distillation stream and said vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(11) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(12) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

54. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said first separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) third expansion means connected to said first separation means to receive said first liquid stream and expand it to said intermediate pressure;

(5) a distillation column connected to receive said expanded first vapor stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded first vapor stream;

(7) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(8) second separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a second vapor stream and a second liquid stream;

(9) said distillation column being further connected to said second separation means to receive said second liquid stream so that at least a portion of said expanded first vapor stream is intimately contacted with at least part of said second liquid stream in said distillation column;

(10) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream from a region of said distillation column above that of said vapor withdrawing means;

(11) fourth heat exchange means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said fourth heat exchange means being further connected to said distillation column to supply said heated liquid distillation stream to said distillation column at a location below that of said vapor withdrawing means;

(12) combining means connected to said distillation column and said second separation means to receive said more volatile vapor distillation stream and said second vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(13) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(14) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

55. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) a distillation column connected to receive said expanded cooled natural gas stream, with said distillation column adapted to separate said stream into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded cooled natural gas stream;

(5) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(6) separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a vapor stream and a liquid stream;

(7) dividing means connected to said separation means to receive said liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said liquid stream to said distillation column at a feed location in substantially the same region wherein said vapor distillation stream is withdrawn;

(8) said distillation column being further connected to said dividing means to receive said second portion of said liquid stream so that at least a portion of said expanded cooled natural gas stream is intimately contacted with at least part of said second portion of said liquid stream in said distillation column;

(9) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream from a region of said distillation column above that of said vapor withdrawing means;

(10) fourth heat exchange means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said fourth heat exchange means being further connected to said distillation column to supply said heated liquid distillation stream to said distillation column at a location below that of said vapor withdrawing means;

(11) combining means connected to said distillation column and said separation means to receive said more volatile vapor distillation stream and said vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(12) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(13) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

56. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus includes

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a first vapor stream and a first liquid stream;

(3) second expansion means connected to said first separation means to receive said first vapor stream and expand it to an intermediate pressure;

(4) third expansion means connected to said first separation means to receive said first liquid stream and expand it to said intermediate pressure;

(5) a distillation column connected to receive said expanded first vapor stream and said expanded first liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded first vapor stream;

(7) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(8) second separation means connected to said third heat exchange means to receive said cooled vapor distillation stream and separate it into a second vapor stream and a second liquid stream;

(9) dividing means connected to said second separation means to receive said second liquid stream and to divide it into at least a first portion and a second portion, said dividing means being further connected to said distillation column to supply said first portion of said second liquid stream to said distillation column at a feed location in substantially the same region wherein said vapor distillation stream is withdrawn;

(10) said distillation column being further connected to said dividing means to receive said second portion of said second liquid stream so that at least a portion of said expanded first vapor stream is intimately contacted with at least part of said second portion of said second liquid stream in said distillation column;

(11) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream from a region of said distillation column above that of said vapor withdrawing means;

(12) fourth heat exchange means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said fourth heat exchange means being further connected to said distillation column to supply said heated liquid distillation stream to said distillation column at a location below that of said vapor withdrawing means;

(13) combining means connected to said distillation column and said second separation means to receive said more volatile vapor distillation stream and said second vapor stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(14) said first heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(15) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

57. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus consists essentially of

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure;

(2) second expansion means connected to said second heat exchange means to receive said cooled natural gas stream and expand it to an intermediate pressure;

(3) a distillation column connected to receive said expanded cooled natural gas stream, with said distillation column adapted to separate said stream into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(4) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(5) control means adapted to regulate the quantity and temperature of said feed stream to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

58. In an apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, in said apparatus there being

(a) one or more first heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure to condense at least a portion of it and form a condensed stream; and

(b) first expansion means connected to said first heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream;

the improvement wherein said apparatus consists essentially of

(1) one or more second heat exchange means cooperatively connected to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) separation means connected to said second heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a liquid stream;

(3) second expansion means connected to said separation means to receive said vapor stream and expand it to an intermediate pressure;

(4) third expansion means connected to said separation means to receive said liquid stream and expand it to said intermediate pressure;

(5) a distillation column connected to receive said expanded vapor stream and said expanded liquid stream, with said distillation column adapted to separate said streams into a volatile residue gas fraction containing a major portion of said methane and lighter components and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) said first heat exchange means connected to said distillation column to receive said volatile residue gas fraction, with said first heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream; and

(7) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

59. The improvement according to claim 33, 34, 35, 57, or 58 wherein said apparatus includes

(1) compressing means connected to said distillation column to receive said volatile residue gas fraction and compress it; and

(2) said first heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

60. The improvement according to claim 31 wherein said apparatus includes

(1) compressing means connected to said distillation column to receive said volatile residue gas fraction and compress it;

(2) said first heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it; and

(3) said dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said

condensed stream and said liquid stream, said dividing means being further connected to said distillation column to direct said liquid stream into said distillation column as a top feed thereto.

61. The improvement according to claim 32 wherein said apparatus includes

(1) compressing means connected to said distillation column to receive said volatile residue gas fraction and compress it;

(2) said first heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it; and

(3) said dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and said second liquid stream, said dividing means being further connected to said distillation column to direct said second liquid stream into said distillation column as a top feed thereto.

62. The improvement according to claim 36 wherein said apparatus includes

(1) compressing means connected to said distillation column to receive said volatile residue gas fraction and compress it;

(2) said first heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it; and

(3) said second dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and said liquid stream, said second dividing means being further connected to said distillation column to direct said liquid stream into said distillation column as a top feed thereto.

63. The improvement according to claim 37 or 38 wherein said apparatus includes

(1) compressing means connected to said distillation column to receive said volatile residue gas fraction and compress it;

(2) said first heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it; and

(3) said second dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and said second liquid stream, said second dividing means being further connected to said distillation column to direct said second liquid stream into said distillation column as a top feed thereto.

64. The improvement according to claim 39 wherein said apparatus includes

(1) compressing means connected to said distillation column to receive said more volatile vapor distillation stream and compress it; and

(2) said combining means connected to said separation means and said compressing means to receive said vapor stream and said compressed more volatile vapor distillation stream and combine them to form said volatile residue gas fraction containing a major portion of said methane and lighter components.

65. The improvement according to claim 40 wherein said apparatus includes

(1) compressing means connected to said distillation column to receive said more volatile vapor distillation stream and compress it; and

(2) said combining means connected to said second separation means and said compressing means to receive said second vapor stream and said compressed more volatile vapor distillation stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components.

66. The improvement according to claim 41, 42, 45, or 46 wherein said apparatus includes

(1) compressing means connected to said contacting and separating means to receive said volatile residue gas fraction and compress it; and

(2) said first heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

67. The improvement according to claim 43, 44, 47, 48, 49, 50, 51, 52, 53, 54, 55, or 56 wherein said apparatus includes

(1) compressing means connected to said combining means to receive said volatile residue gas fraction and compress it; and

(2) said first heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

68. The improvement according to claim 33, 34, 35, 57, or 58 wherein said apparatus includes

(1) heating means connected to said distillation column to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said first heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

69. The improvement according to claim 31 wherein said apparatus includes

(1) heating means connected to said distillation column to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it;

(3) said first heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it; and

(4) said dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and said liquid stream, said dividing means being further connected to said distillation column to direct said liquid stream into said distillation column as a top feed thereto.

70. The improvement according to claim 32 wherein said apparatus includes

(1) heating means connected to said distillation column to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it;

(3) said first heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it; and

(4) said dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and said second liquid stream, said dividing means being further connected to said distillation column to direct said second liquid stream into said distillation column as a top feed thereto.

71. The improvement according to claim 36 wherein said apparatus includes

(1) heating means connected to said distillation column to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it;

(3) said first heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it; and

(4) said second dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and said liquid stream, said second dividing means being further connected to said distillation column to direct said liquid stream into said distillation column as a top feed thereto.

72. The improvement according to claim 37 or 38 wherein said apparatus includes

(1) heating means connected to said distillation column to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it;

(3) said first heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said first heat

exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it; and

(4) said second dividing means connected to said first heat exchange means to receive said condensed portion and divide it into at least two portions, forming thereby said condensed stream and said second liquid stream, said second dividing means being further connected to said distillation column to direct said second liquid stream into said distillation column as a top feed thereto.

73. The improvement according to claim 39 wherein said apparatus includes

(1) heating means connected to said distillation column to receive said more volatile vapor distillation stream and heat it;

(2) compressing means connected to said heating means to receive said heated more volatile vapor distillation stream and compress it;

(3) cooling means connected to said compressing means to receive said compressed heated more volatile vapor distillation stream and cool it;

(4) said combining means connected to said separation means and said cooling means to receive said vapor stream and said cooled compressed more volatile vapor distillation stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components.

74. The improvement according to claim 40 wherein said apparatus includes

(1) heating means connected to said distillation column to receive said more volatile vapor distillation stream and heat it;

(2) compressing means connected to said heating means to receive said heated more volatile vapor distillation stream and compress it;

(3) cooling means connected to said compressing means to receive said compressed heated more volatile vapor distillation stream and cool it;

(4) said combining means connected to said second separation means and said cooling means to receive said second vapor stream and said cooled compressed more volatile vapor distillation stream and combine them to form a volatile residue gas fraction containing a major portion of said methane and lighter components.

75. The improvement according to claim 41, 42, 45, or 46 wherein said apparatus includes

(1) heating means connected to said contacting and separating means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said first heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

76. The improvement according to claim 43, 44, 47, 48, 49, 50, 51, 52, 53, 54, 55, or 56 wherein said apparatus includes

(1) heating means connected to said combining means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said first heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said first heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

77. The improvement according to claim 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 64, 65, 69, 70, 71, 73 or 74, wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

78. The improvement according to claim 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 64, 65, 69, 70, 71, 73 or 74, wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

79. The improvement according to claim 19 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

80. The improvement according to claim 20 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

81. The improvement according to claim 21 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

82. The improvement according to claim 24 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

83. The improvement according to claim 25 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

84. The improvement according to claim 26 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

85. The improvement according to claim 19 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

86. The improvement according to claim 20 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

87. The improvement according to claim 21 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

88. The improvement according to claim 24 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

89. The improvement according to claim 25 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

90. The improvement according to claim 26 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, C_2 components, and C_3 components.

91. The improvement according to claim 59 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

92. The improvement according to claim 63 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

93. The improvement according to claim 65 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

94. The improvement according to claim 67 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

95. The improvement according to claim 68 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

96. The improvement according to claim 72 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

97. The improvement according to claim 75 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.

98. The improvement according to claim 76 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and C_2 components.